

Chapter 3.1

Stream nitrate in the Maryland Coastal Bays watershed

Catherine Wazniak¹, Daniel Boward², Niles Primrose³, and Jonathan Dillow⁴

¹Maryland Department of Natural Resources, Tidewater Ecosystem Assessment, Annapolis, MD 21401

²Maryland Department of Natural Resources, Monitoring and Non-Tidal Assessment, Annapolis, MD 21401

³Maryland Department of Natural Resources, Chesapeake and Coastal Watershed Service, Annapolis, MD 21401

⁴United States Geological Survey, Maryland-Delaware-Washington D.C. District, Baltimore, MD 21237

Abstract

High stream nitrate was observed in all Coastal Bays segments. Stream nitrate is a relative measure of nutrients entering the system. High levels indicate excess inputs from human activities. These inputs are transported to the bays via surface runoff and groundwater. Streams and small creeks are often the initial receptors of pollutants, which then travel downstream to the bays.

Most streams in the Coastal Bays watershed were degraded with excess nitrogen. A majority of streams failed the nitrate threshold suggesting human inputs are high. Streams with more intensive monitoring programs appeared to have more sporadic stormwater inputs and, overall, had higher concentrations of stream nitrate. Many tributaries, even in the relatively undeveloped Chincoteague Bay watershed, had stream nitrate values indicative of enrichment from human activities.

Introduction

Stream nitrate measured during low flow periods is a relative measure of the groundwater nutrients entering the system, while during high flow periods (i.e., storms) it is a measure of land run-off. Stream nitrate monitoring is not a true estimate of loading, as it does not directly evaluate reductions of nutrient inputs due to ecological processes (e.g., denitrification) that may take place as the water enters the stream or flows through wetlands. High anthropogenic inputs were indicated by nitrate values above 1 mg/L (Morgan 1995; Roth et al. 2003).

Methods

Stream nitrate data were collected during special studies by the United States Geological Survey (USGS) and the Maryland Department of Natural Resources (DNR), in

conjunction with the Maryland Department of the Environment (MDE). USGS data was collected from southern bay tributaries (Figure 3.1.1) during 1999 and 2000 (Dillow et al. 2002). DNR data were collected through the Maryland Biological Stream Survey (MBSS) program during 2001 (Roth et al. 2003). DNR and MDE conducted a cooperative study collecting weekly samples at Birch Branch (Figure 3.1.1). In addition, four stations included in DNR's routine monthly water quality monitoring program were in non-tidal tributaries (See Section 4).

Management Objective: Decrease nitrogen loading to streams

Indicator: Maximum stream nitrate < 1 mg/L

Results

Maximum stream nitrate concentrations for each station sampled in all of the programs mentioned above are shown in Figure 3.1.1. Broken down by Coastal Bays segment, stream nitrate levels appeared worse in the northern bays (Assawoman Bay, St. Martin River, and Isle of Wight Bay) than in those further south (Newport, Sinepuxent, and Chincoteague Bays). In Assawoman Bay, two stations failed the threshold level and contained very high concentrations of nitrate. All 16 stations in the St. Martin River watershed failed the threshold level with the exception of South Branch (Figure 3.1.1).

Assawoman Bay

The single station in this segment did not meet the nitrate threshold, with very high levels of nitrate (maximum greater than 5 mg/L) (Figure 3.1.1).

St. Martin River

All 16 stations did not meet the nitrate threshold, except one on the South Branch (Figure 3.1.1).

Isle of Wight Bay

All six stations on upper Turville Creek did not meet the nitrate threshold (Figure 3.1.1).

Sinepuxent Bay

Two of the four stations in Sinepuxent Bay watershed met the nitrate threshold (Figure 3.1.1).

Newport Bay

Ten of 14 stations did not meet the nitrate threshold. One station on upper Trappe Creek met the threshold, while three more met the threshold in the southern portion of the watershed (Figure 3.1.1).

Chincoteague Bay

Eight out of 16 sites did not meet the nitrate threshold. Three sites that met the threshold were located in the middle section of the watershed (Figure 3.1.1).

Summary

Most streams, especially in the northern watersheds, were degraded based on nitrate concentration. Upper tributaries were severely nutrient enriched. A majority of streams failed the nitrate threshold suggesting that human inputs were high. Additionally, streams with more intensive monitoring programs appeared to have more sporadic stormwater type inputs and overall had higher concentrations of stream nitrate. The St. Martin River and northern Assawoman Bay watersheds were the most impacted by high nitrate concentrations, while streams flowing into Sinepuxent Bay and northern Chincoteague Bay had the lowest total nitrate concentrations. Since the two former watersheds cross state boundaries (Delaware and Maryland), cooperative agreements to curb nitrate input will be necessary.

Stream nitrate data do not directly evaluate reductions of nutrients because of the often sporadic or ephemeral nature of storm events causing large amounts of run-off. If this is desired, a more specific intensive stormwater monitoring program should be developed. Low flow period and changes in groundwater inputs should be a focus of future monitoring strategies. Another issue is the extensive ditching of many tributaries and creeks that may be allowing groundwater to enter streams faster, thus decreasing the filtration normally encountered before entering the bays. While documented, further work on management options for this problem is warranted.

Acknowledgements

Thanks to the Maryland Department of the Environment for helping to fund analyses at the Birch Branch gage station.

References

- Dillow, J.J.A., W.S.L. Banks, and M.J. Smigaj. 2002. Ground-water quality and discharge to Chincoteague and Sinepuxent Bays adjacent to Assateague Island National Seashore, Maryland. Water Resources Investigations Report 02-4029. United States Geological Survey, Baltimore, MD.
- Morgan, R. 1995. Personal communication. University of Maryland Center for Environmental Science, Appalachian Laboratory, Frostburg, MD.
- Roth, N.E., M.T. Southerland, G.M. Rogers, and J.H. Volstad. 2003. Maryland Biological Stream Survey 2000-2004. Volume II: Ecological Assessment of Watersheds Sampled in 2001. Prepared by Versar, Inc., Columbia, MD with Maryland Department of Natural Resources, Monitoring and Non-Tidal Assessment Division.

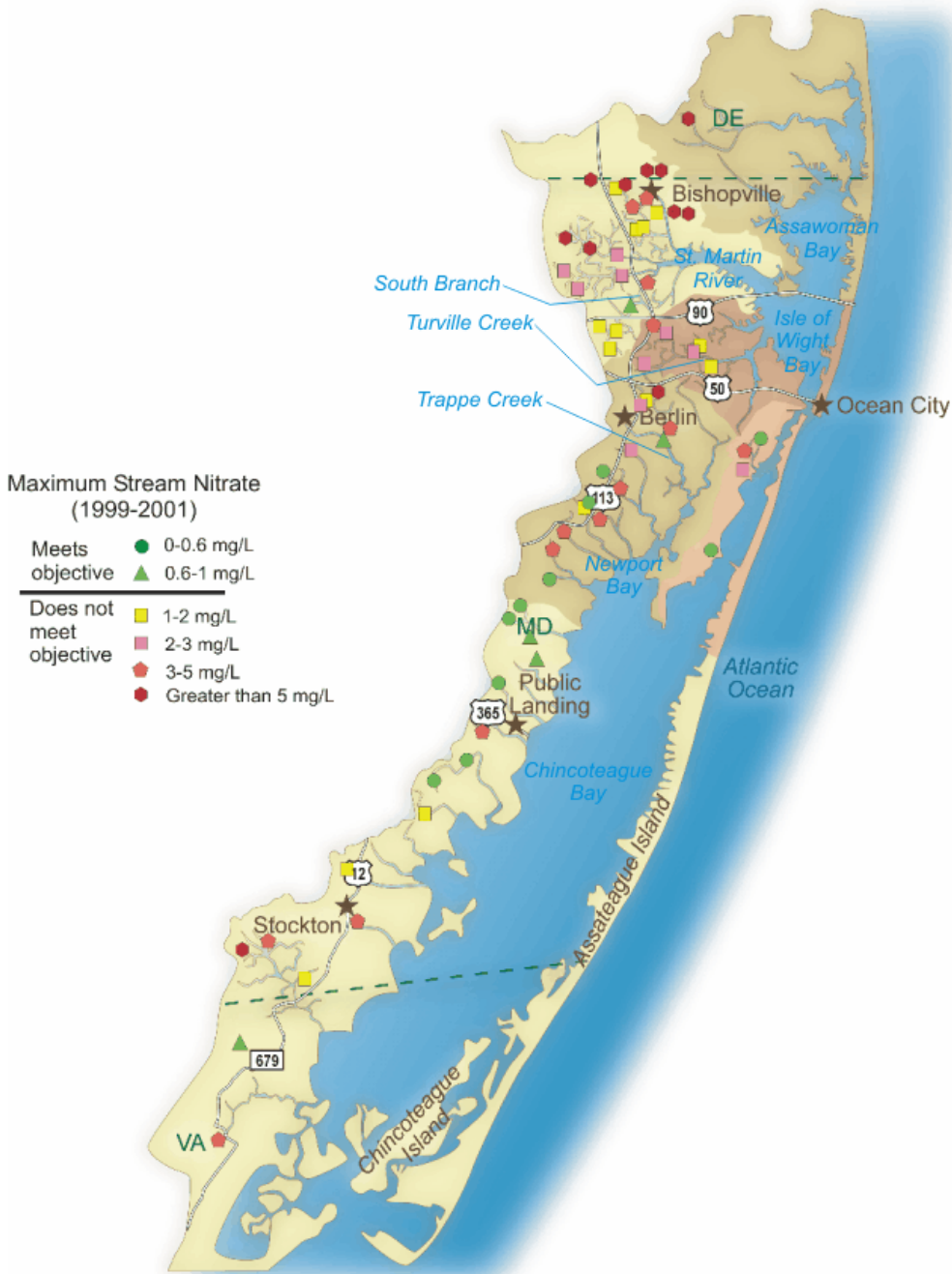


Figure 3.1.1: Maximum total stream nitrate (mg/L) measured by USGS in 1999 and 2000 and DNR/MDE (MBSS) in 2001 for tributaries in the Coastal Bays watershed. Coastal Bays segments are shown as well as individual streams indicated in the text.